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ORIGINAL

Protein intake and weight gain among low-income pregnant women from *Mesquita* County, *Rio de Janeiro*, Brazil

Consumo de proteína e ganho de peso entre gestantes de baixa renda do município de Mesquita, Rio de Janeiro, Brasil

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ABSTRACT

Objective

To evaluate the effect of protein intake on body weight gain at pregnancy.

Methods

A cross-sectional study was carried out with 297 women who delivered a child at the maternity ward of Municipal Hospital Leonel de Moura Brizola in *Mesquita* city in the state of *Rio de Janeiro*. Sociodemographic and anthropometric data were collected through the use of a structured questionnaire at first week after delivery. Food intake was assessed by a food frequency questionnaire. Protein intake per kilogram of body weight (g/kg per day) during pregnancy was categorized as high or low protein intake according to overall median

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levels. Hierarchical multiple linear regression was fitted to estimate the effect of protein intake per kg during pregnancy on weight gain.

Results

Women presented an average weight gain of 12.8kg (SD=6.34) and 26.8kg/m^2 (SD=4.78) of Body Mass Index. Those who consumed a diet with high levels of protein content significantly presented less weight at postpartum (p<0.01) lower Early-Pregnancy Body Mass Index (p<0.01). In the hierarchical linear regression, it was found a negative association of protein intake per kg and Weight gain (β=-4.3025; IC95%=-6.0215; -2.5836; p<0.01). In the final model, all others covariates (energy, schooling, family income and gestational age) were significantly associated with the outcome (p<0.05). The additional model showed a negatively association between Early-Pregnancy Body Mass Index and weight gain (β=-0.2951; IC95%= -0.4987; -0.0915; p<0.01).

Conclusion

Higher levels of protein intake per kg of body weight during pregnancy were associated with lower weight gain.

Keywords: Pregnancy. Protein intake. Weight gain.

RESUMO

Objetivo

Este estudo teve como objetivo testar a associação entre a ingestão de proteína e o ganho de peso na gestação.

Métodos

Foi realizado um estudo transversal com 297 mulheres que deram à luz na maternidade do Hospital Municipal Leonel de Moura Brizola, na cidade de Mesquita, situada na baixada do estado do Rio de Janeiro. Os dados sociodemográficos e antropométricos foram coletados na primeira semana após o parto, com base em um questionário estruturado. Aplicou-se um questionário de frequência do consumo alimentar para avaliar a Ingestão de Proteína durante a gravidez, que foi classificada como alta ou baixa de acordo com os valores medianos observados. Adotou-se a regressão hierárquica linear múltipla para estimar o efeito da ingestão de proteína (ptn) por quilograma (kg) sobre o ganho de peso.

Resultados

As gestantes apresentaram, em média, um ganho de peso de 12,8kg (DP=6,34) e um Índice de Massa Corporal Pré-Gestacional de 26,8kg/m^2 (DP=4,78). As gestantes com alta ingestão de proteína apresentaram valores significantemente menores em relação ao peso no pós-parto (p<0,01) e ao Índice de Massa Corporal pré-gestacional (p<0,001). No modelo final, todas as covariáveis (energia, escolaridade, renda familiar e idade gestacional) foram associadas ao desfecho (p<0,05), sendo verificada uma associação negativa entre a ingestão de ptn/kg e o ganho de peso (β=-4.3025; -6.0215; -2.5836 IC95%; p<0,01). No modelo adicional, observou-se uma associação negativa entre o Índice de Massa Corporal Pré-Gestacional e o ganho de peso (β=-4.3025; IC95%=-6.0215; -2.5836; p<0,01).

Conclusão

A pesquisa concluiu que teores elevados de proteína dietética foram associados com menores valores de ganho de peso na gestação.

Palavras-chave: *Gravidez. Ingestão de proteína. Ganho de peso.*

INTRODUCTION

Pregnancy is a period when women are more susceptible to keep or develop overweight and obesity [1] due to the excessive weight gained or the difficulty of returning to pre-pregnancy weight. According to the Institute of Medicine (IOM) dietary recommendations [2] the adequate weight gain during pregnancy can prevent weight retention after childbirth [3-5]. Nevertheless, a significant fraction of pregnant women does not gain weight within the ranges proposed by IOM [6,7] and the largest increase usually occurs during the second and third trimesters [8].

For pregnant women with a single fetus, predicted weight gain ranges from 5kg to 18kg and the marginal weight gain depends on the classification of pre-pregnancy nutritional status [2], which is measured according to the Body Mass Index (BMI). IOM recommends that the estimated energy requirement for pregnant women is individualized [9]. For its calculation the following factors should be considered: age, weight, height and physical activity level.

To ensure the adequate fat deposition and meet the increased metabolic expenditure at pregnancy, a rise in energy is proposed during the last two gestational trimesters ranging from 300 to 450kcal between the second and the third gestational trimesters [9]. The energy requirement percentage for pregnant women can range from 46% to 65% for carbohydrates, and 20% to 35% for lipids [2]. With respect to protein, the proposed percentage range is wide, varying from 10% to 35% for adults. During pregnancy, the recommended daily consumption is 1.1 grams per kilogram of body weight [2].

Although some beneficial evidence about nutritional interventions during pregnancy has been found, including protein supplementation, they have not been adopted due to questionable effectiveness of these interventions [10]. According to Lai *et al*. [11], higher intake of plant-based protein foods could be beneficial for the adequate weight gain at pregnancy. Also, recent evidence has suggested a positive effect of diets with higher protein content on weight loss and body composition [12]. However, current studies reinforce the limited and inconsistent literature on protein intake and weight gain during pregnancy [13,14]. No clinical trials were found during pregnancy due to the lack of assurance of performing a trial in a reproductive period. According to a longitudinal analysis [15], an additional weight loss was showed among 421 Brazilian pregnant women who consumed 1.2g of protein during pregnancy. Thus, the aim of this observational study was to evaluate the association between higher levels of protein intake per kg of body weight [g/kg] and the weight gain during pregnancy.

METHODS

A cross-sectional analysis was conducted as part of the baseline study of a cohort entitled "Effect of Nutritional Determinants, Socio-Demographic and Reproductive Variation in the Postpartum Weight and in the Development of Co-morbidities". The sample consisted of 334 women who gave birth in the maternity of the *Hospital Municipal Leonel de Moura Brizola* (HMLMB, Municipal Hospital Leonel de Moura Brizola) located in the county of *Mesquita*, state of *Rio de Janeiro* [16].

The evaluation occurred between February 2009 and February 2011. The eligibility criteria were: age between 18 and 45 years, single pregnancy and no pre-existing chronic diseases, except obesity. From the 334 postpartum women that accepted to participate in the research, 7 (2.1%) were excluded because the reported energy intake was higher than 6,000kcal/ day [17,18], and 3 (0.9%) had weight gain higher than 35kg or lower than 1kg. From 324 postpartum women considered eligible, 27 (8.3%) were missed because had no information of weight gain. Thus, the final sample comprised 297 (91.7%) women.

Interviews were conducted during the first week after delivery, in the maternity ward. Interviewers were trained and data collection was standardized. Data were obtained through the use of a structured questionnaire, which included anthropometric, socio-demographic and lifestyle information. The Ethics Committee of the Institute of Social Medicine of *Universidade Estadual do Rio de Janeiro* (State University of *Rio de Janeiro*) approved the study, under CAAE protocol - 0022.0.259.000-09 and the participation was voluntary. All participants received information relating to the context, procedures and objectives of the study and a written consent was signed.

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Participants body fat percentage (BF%) and weight (kg) were estimated by bioelectrical impedance, using Tanita® (Tanita Inner Scan, Tanita Corporation of America, Inc., Illinois, United States). Height was measured in centimeters, to the nearest tenth, using a stadiometer from Alturaexata® (Alturaexata, *Belo Horizonte*, Brazil). Weight and height were obtained with the subject in light indoor clothes and no shoes. The measurement of anthropometric data followed the protocol established by Lohman *et al*. [19].

The Early-Pregnancy Weight (EPW) was obtained from the mother's card when the information was referring up to the 13th gestational week. In the absence of both records, the information was self-reported by the mothers. Weight Gain (WG) was defined as the difference between the weight on the day of delivery (or in the last prenatal visit after the 38th gestational age) and the EPW. Early-Pregnancy Body Mass Index (EPBMI) was calculated from the EPW and the height measured in the first week after delivery. Weight gain (yes or not) was calculated based on EPBMI and using the Institute of Medicine recommendations [20].

Actual Body Mass Index (BMI) in postpartum was obtained from current weight (kg) and height (m) (BMI: weight/ height*height).

Information on dietary intake (energy, protein, carbohydrates and lipids) was obtained through a Food Frequency Questionnaire (FFQ), previously validated by Sichieri & Everhart [21]. All volunteers were instructed to report the usual dietary intake from the last six months, which included the second and third trimesters of pregnancy, at the time of the interview. Women indicated the number of servings and the frequency of use of each of the 81 items listed in the FFQ: More than three times a day, 2 to 3 times per day, 1 time per day, 5 to 6 times per week, 2 four times per week, one time per week, 2 to 3 times per month, one time per month, and never or hardly ever. The protein and energy dietary intake were obtained multiplying the daily frequencies (mean frequency /7) by the household servings (grams) from Pinheiro [22]. The *Tabela Brasileira de Composição de Alimentos* (TBCA, Brazilian Food Composition Table) [23] was used to access the nutritional composition of the dietary intake. The converted values were calculated in a program developed by Sichieri [24] using Statistical Analysis System (SAS) version 9.3 (SAS Institute, Inc., Cary, North Carolina, United States) [25]. The FFQ has been shown to be valid for assessing dietary intake among pregnant women to rank people according to their food intake [26] and to distinguish between subgroups [27].

The following sociodemographic factors were considered as covariates: age (years), schooling (years at school – last grade studied with approval), skin color (mixed and black or white), marital status (married/ union or single/ other), parity (number of children) and family income (dollar) per month. Clinical maternal pregnancy characteristics were considered as covariates: gestational age (weeks), working and disease during pregnancy (yes or not), prenatal beginning (weeks).

Data analysis was performed in four stages. First, the normality of the outcome was tested using the Kolmogorov-Smirnov test. Then to ensure the normal distribution of the weight gain outcome variable, this measure was centered in mean value. Also, socio-demographic conditions, anthropometric measures, maternal clinical pregnancy's characteristics and dietary intake covariates of the 297 women were described at baseline. The cutoff to rank maternal protein intake during pregnancy (g/kg per day) as high (HP) or low (LP) was chosen according to median levels of protein intake (1.67g/kg). These values of protein per kilogram did not consider the extreme values of consumption, since the seven cases of consumption >6,000kcal [15,16] were excluded from the analyses and there was no case less than 600kcal. Chi-square and t-student tests were applied to verify the existence of differences according to high (g/kg ≥1.67) or low (g/kg <1.67) protein intake.

Finally, hierarchical model of linear regression was fitted to assess the association between protein intake per kg/day (as continuous) and WG (centered on mean value). The concept of the causal model was based on the hierarchical model [28] to include all covariables that could be associated with weight gain, from a more distal level, sociodemographic factors, to more proximal variables, as energy dietary intake. Thus, the selection of the adjustment variables was performed by hierarchical blocks: 1st block of socio-demographic conditions (age, education level, ethnicity, marital status, parity and family income); 2sd block of anthropometric measures before delivery (EPW and EPBMI); 3rd block of maternal clinical characteristics were considered as covariate: gestational age (weeks), worked and illness during pregnancy (yes or not), prenatal beginning (weeks); and 4th block of maternal dietary intake (energy intake). Protein per kilogram of body weight was considered as independent variable. Covariates into de blocks with *p*-value ≤0.20 were maintained in the model that was adjusted for education level, family income, gestational age, energy. Additional model included EPBMI and work during pregnancy. The database was developed on the statistical program Epi Info® (CDC – Centers of Disease Control and Prevention, Atlanta, Georgia, United States) version 6.04 and the analyses were performed in the statistical package SAS. The manuscript was reported in accordance to Strobe [29].

RESULTS

Postpartum women presented on average weight gain of 12.8 (SD=6.34) and ranged from 1.3kg to 33kg, and the interquartile range was 7.0kg. From the 297 postpartum women, 112 (37.7%) presented adequate weight gain and 73 (24.6%) were classified as overweight women, 55 (75.3%) had inadequate weight gain. The median protein intake per kilogram of body weight was 1.67 (SD=0.75) for all women, 2.16 (SD=0.59) among HP group and 1.20 (SD=0.30) among LP group. Mean protein intake per kg was 2.46 (SD=0.61) and 1.22 (SD=0.34) to HP and LP groups, respectively. It was observed mean value of 24.8 (SD=5.43) years of age, reported 8.83 (SD= 3.03) years of schooling, and 2.17 (SD=1.29) parturitions. About 80.0% of women were black or mixed skin colored and more than 70.0% reported being married or living with a partner (Table 1). On average, these mothers measured 1.61m (SD= 6.40) and weighted 69.3 kg (SD=13.4). EPBMI was 23.4kg/m^2 (SD=4.33) and energy intake during pregnancy was of 2,882kcal (SD=1,081), which was composed by 118g (SD=43.7) of protein, which was respectively by 16.0% of total energy intake. Women who reported an HP during pregnancy presented lower weight at postpartum (<0.01) and EPBMI (<0.01) than those with LP (Table 1).

Regarding the hierarchical model of linear regression (Table 2), a negative association was observed in final model (β=-4.3025; IC95%=-6.0215; -2.5836; *p*<0.01) between protein intake per kg and Weight Gain. In the final model, all others covariates (energy, schooling, family income and gestational age) were significantly associated with the outcome (*p*<0.05). The additional model showed a negatively association between EPBMI and weight gain (β=-0. 2951; IC95%=-0.4987; -0.0915; *p*<0,01).

DISCUSSION

The present study showed that higher levels of protein intake per kg of body weight were associated with lower WG during pregnancy. Women who reported a protein intake equal or above the median intake during pregnancy presented lower weight, body fat percentage and EPW. WG was associated positively associated with EPW and energy.

Our results should be interpreted in consideration of some limitations. As with all observational studies, it is possible that we

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Table 1. Anthropometric, dietary intake and sociodemographic characteristics of 297 postpartum women in Municipal Maternity *Hospital Leonel de Moura Brizola*. *Mesquita* (RJ), 2011.

Variables	All (n=297)		HP (n=147)		LP (n=150)		*p*-value*
	Mean	SD	Mean	SD	Mean	SD	
Anthropometrics							
Weight (kg)	69.30	13.40	64.30	9.96	74.40	14.50	<0.01
Height (m)	1.61	6.40	1.60	6.26	1.62	6.36	<0.01
EPW (kg)	60.50	12.20	56.20	9.45	64.70	13.20	<0.01
EPBMI (kg/m^2)	23.40	4.33	22.00	3.41	24.70	4.75	<0.01
Weight gain (kg)	12.80	6.34	12.40	5.78	13.30	6.17	0.22
Weight retain (kg)	8.95	6.93	8.15	5.77	9.76	7.87	0.05
Dietary Intake							
Energy (kcal)	2.882	1.081	3.603	894	2.176	724	<0.01
Protein (g/kg)	1.77	0.75	2.46	0.61	1.22	0.34	<0.01
Protein (g)	118.00	43.70	150.00	35.40	87.30	25.20	<0.01
Socio-Demographics							
Age (years)	24.80	5.43	24.80	5.64	24.80	5.24	0.89
Schooling (years)	8.83	3.03	8.68	2.90	8.98	3.17	0.41
Parity (n)	2.17	1.29	2.16	1.26	2.17	1.32	0.98
Family income (dollar)	362.00	226.00	380.00	226.00	344.00	226.00	0.20
Maternal clinical characteristics							
Prenatal beginning (weeks)	12.60	6.96	12.50	6.99	12.80	6.94	0.73
Gestational age (weeks)	39.30	1.51	39.20	1.70	39.40	1.29	0.14
	n	%	n	%	n	%	*p*-value**
Socio-Demographics							
Skin color (reported)							0.70
Black or Mixed	245	82.5	120	81.6	125	83.3	
White	52	17.5	27	18.4	25	16.7	
Marital Status							0.53
Married/Union	234	79.6	118	80.8	116	77.9	
Single/Other	60	20.4	28	19.2	32	21.5	
Maternal clinical characteristics							
Worked at pregnancy							0.62
Yes	121	40.7	62	42.2	59	39.3	
No	176	59.3	85	57.8	91	60.7	
Illness at pregnancy							0.37
Yes	63	21.2	28	19.1	35	23.3	
No	234	78.8	119	80.9	115	76.7	

Note: *Student's *t*-Test. **Chi-square.

EPW: Early-Pregnancy Weight; EPBMI: Early-Pregnancy Body Mass Index; SD: Standard Deviation; HP: High Protein Intake; LP: Low Protein Intake.

did not completely adjust for known factors associated with the outcome. Similarly, because data are cross-sectional, the causative nature of associations cannot be determined. Moreover, diet was assessed through the use of a FFQ, which has some restraints in assessing dietary intake. Also, social desirability bias might be present. However, we believe that the possible bias of

Table 2. Hierarchical linear regression to estimate the association of protein intake per body weight with weight gain at pregnancy. *Mesquita* (RJ), 2011.

Variables	Hierarchical linear regression			
	β	SD	*p*-value	95%CI
Unadjusted linear regression				
Protein (grams/ kg)	-0.1419	0.0783	0.071	-0.2959; 0.0122
Adjusted linear regression				
1st Block				
Schooling (years)	0.0540	0.0253	0.034	0.0041; 0.1039
Parity (n)	0.0347	0.0555	0.533	-0.0746; 0.1440
Family income (dollar)	-0.0002	0.0001	0.138	-0.0005; 0.0001
Marital status (union)	-0.0906	0.1040	0.385	-0.2955; 0.1143
Skin color	0.0032	0.0573	0.955	-0.1096; 0.1160
1st Block plus 2sd Block				
Schooling (years)	0.0506	0.0231	0.030	0.0051; 0.0961
Family income (dollar)	-0.0002	0.0001	0.157	-0.0005; 0.0001
EPW (kg)	0.0028	0.0131	0.832	-0.0230; 0.0286
EPBMI (kg/m^2)	-0.0170	0.0365	0.642	-0.0888; 0.0548
1st Block plus 3rd Block				
Schooling (years)	0.2728	0.1482	0.067	-0.0192; 0.5648
Family income (dollar)	-0.0017	0.0010	0.079	-0.0037; 0.0002
Gestational age (weeks)	-0.4798	0.3408	0.161	-1.1515; 0.1919
Worked at pregnancy	-0.9582	0.8540	0.263	-2.6412; 0.7248
Illness at pregnancy	0.4001	1.0329	0.699	-0.1656; 2.4357
Prenatal beginning (weeks)	-0.0428	0.0608	0.482	-0.1627; 0.0771
1st Block and 3rd Block plus 4th Block				
Schooling (years)	0.3378	0.1442	0.020	0.0538; 0.6219
Family income (dollar)	-0.0020	0.0009	0.040	-0.0038; 0.0001
Gestational age (weeks)	-0.4923	0.3378	0.146	-1.1579; 0.1733
Energy (kcal)	0.0007	0.0004	0.078	-0.0001; 0.0015
Final Model				
Protein (grams/kg)	-4.3025	0.8722	<0.01	-6.0215; -2.5836
Schooling (years)	0.3142	0.1436	0.030	0.0311; 0.5972
Family income (dollar)	-0.0021	0.0009	0.024	-0.0039; 0.0003
Gestational age (weeks)	-0.7478	0.3288	0.024	-1.3959; -0.0100
Energy (kcal)	0.0031	0.0006	<0.01	-0.0019; 0.0043
Additional Model[*]				
Protein (grams/kg)	-5.5084	0.9734	<0.01	-7.4269; -3.5899
Schooling (years)	0.3310	0.1418	0.020	0.0516; 0.6104
Family income (dollar)	-0.0018	0.0009	0.044	-0.0036; 0.00004
Gestational age (weeks)	-0.5929	0.3279	0.072	-1.2392; 0.0535
Energy (kcal)	0.0036	0.0006	<0.01	-0.0023; 0.0048
EPBMI (kg/m^2)	-0.2951	0.1033	<0.01	-0.4987; -0.0915
Worked at pregnancy	-0.6644	0.8016	0.408	-2.2443; 0.9156

Note: [*]Additional model included EPBMI and worked at pregnancy.

EPW: Early-Pregnancy Weight; EPBMI: Early-Pregnancy Body Mass Index; SD: Standard Deviation; CI: Confidence Interval.

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using a predetermined food list had a very low effect, because it was previously validated and studies have shown that the FFQ has acceptable validity and reproducibility [30,31]. Also, FFQs have been widely used to collect dietary data and measure the nutritional assessment at pregnancy and postpartum periods [32,33].

Aside from the above limitations, the present study has aspects that favor the validity of the results. Analyses were performed until the first week after delivery and data was collected at the maternity ward, minimizing memory bias regarding information on dietary intake and reproductive history. The sample size and the low refusal of participation should also be considered to increase the validity of the study, by increasing statistical power.

With regard to the outcome, the average protein intake observed during pregnancy was 1.67g/kg per day. It was higher than the 1.1g/kg recommended by IOM [9] from the second trimester on. Despite this dietary recommendation being expected to supply about 97% of pregnant women needs, there is still no consensus on the recommendation of diets with higher levels of protein during this period. According to the review by Kramer & Kakuma [34], the low evidence regarding the benefit in supplementation combined with the possibility of damage, do not justify the prescription of a high protein diet during pregnancy.

On the other hand, a recent intervention study with 132 Dutch participants randomly undergoing energy-restricted diets with different levels of protein and carbohydrates, carried out by Soenen *et al*. [35] showed a positive association of protein intake levels with weight loss and its maintenance.

Few studies regarding protein intake were performed during reproductive period [11-15,36,37]. The review conducted by Ota *et al*. [36] encouraged the evidence that antenatal nutritional education increased the balance in energy and protein intake. Even though overestimation of protein intake during pregnancy could occur, it has been shown that the FFQ is a valid instrument to measure food intake and classify people among subgroups of dietary composition [24,25]. According to Maslova *et al*. [37] pregnant women in the highest quintile of the protein/carbohydrate intake *ratio* had lower body weight gain than women who consumed less protein or more carbohydrate.

The weight loss associated to higher levels of protein described in literature [36,38-40] has been suggested by an increase in satiety and/or the heat increase provided by this macronutrient. Martens *et al*. [40] showed that individuals with higher protein intake to carbohydrate ate less and presented lower desire to eat. Also, a systematic review conduct by Wycherley *et al*. [39] highlighted the greater satiety provided by protein intake and its benefits on body weight reduction. Likewise, Noakes *et al*. [38] found the nutritional, metabolic, and often higher benefits of a hyper protein diet comparing to a conventional one. These findings were obtained from a randomized clinical trial with 119 overweight women. The study compared the effect of energy restriction through a diet rich in protein and low in fat, as opposed to a diet with conventional carbohydrates and also low in fat.

Protein origin is another important concern. The meta-analysis conducted by Anderson *et al*. [41] indicated a protective effect of vegetable protein on lipid profile. Similarly, the systematic revision of Pedersen *et al*. [17] concluded that vegetable protein intake was associated with a decreased risk in many studies. Nonetheless, there is a lack of evidence comparing the overall effect of protein intake on weight gain during pregnancy and its consequences in the postpartum period. In the analyses conducted by Castro *et al*. [15] and Castro *et al*. [42] with 421 women, the authors found that protein intake ≥1.2g/kg during pregnancy and postpartum favored weight loss after childbirth. In the present study, hierarchical linear regression analysis showed a negative association between consumption

of protein (g/kg) during pregnancy and WG in the same period. Even though the amount of protein per kg consumed obtained in the analyses was higher than the proposed by the IOM for pregnancy, the mean percentage of protein contributing to the diet was 16% (data not shown), suggesting a proximity to the lower limit of the minimum consumption percentage (10-35%) recommended for adults. The energy consumption during pregnancy was higher among mothers who reported a higher protein intake. Nevertheless, protein intake per kilogram remained higher, as well as the percentage of the total protein composition over the total energy intake.

Excessive weight gained at pregnancy was associated with body weight retention during the postpartum period, which is a public health concern. Predictor factors of excessive weight gain are multifaceted and include maternal nutrition status, pre-gestational BMI, and socioeconomic conditions [43,44]. Overweight women with gestational diabetes tend to gain excessive weight during pregnancy compared to women categorized as normal weight [43]. It is recognized that a proper weight gain is protective against the development of obesity [4,40]. According to Begum *et al*. [45], the early-pregnancy BMI is a predictor of excessive weight gain, and a higher body weight gain is a predictor of weight retention during the postpartum period. This fact is in agreement with our results that showed a negative association between EPW and WG in the additional model. The longitudinal study by Scholl *et al*. [46] with 274 women with adequate early-pregnancy BMI, found that the rate of excessive weight gain contributed to the development of overweight postpartum.

Similarly, it is acknowledged that factors such as age, parity, race, income and education are also considered important determinants of gestational weight gain [5,45,47].

Although the intake of protein has increased in Brazil [48], its consumption seems to be associated with family income [49,50], and the dietary intake seems to be more affected among low income people [51]. Family income can interfere specifically with protein intake as indicated by Tavares *et al*. [52], who observed that protein intake relates to income between Brazilian nursing mothers. The results of a population-based cross-sectional study conducted by Alves *et al*. [53] with women living in an urban area of *Rio Grande do Sul* in Brazil, suggest that income is one of the determinants of food choice and consumption.

This study reinforces the need to call for more research on dietary intake which could be translated to important messages, helping to establish new strategies for women's health and reinforces the importance of nutritional advice in the reproductive period to ensure adequate weight gain and to prevent the development of obesity.

CONCLUSION

A higher protein intake (g/kg per day) during pregnancy showed to favor lower WG. Women who reported a higher protein intake displayed less weight since the early-gestational period. These results reinforce the importance of adequate nutrition during pregnancy, envisaging potential health benefits for both women and offspring.

CONTRIBUTORS

M CABRAL drafted the manuscript, performed the statistical analysis, and contributed to the interpretation of the results and to the discussion of the results; CMM ROCHA performed the statistical analysis and contributed to the interpretation of the results, R SICHIERI conceptualized the study, reviewed and contributed to the discussion of the manuscript, MBT CASTRO conceptualized the study and collected the data, performed the statistical analysis and the interpretation of the data, draft the manuscript and contributed to the discussion of the results. All authors have approved the final version of the submitted manuscript.

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